

Seasonal-to-decadal forecasting with EC-Earth at IC3/BSC

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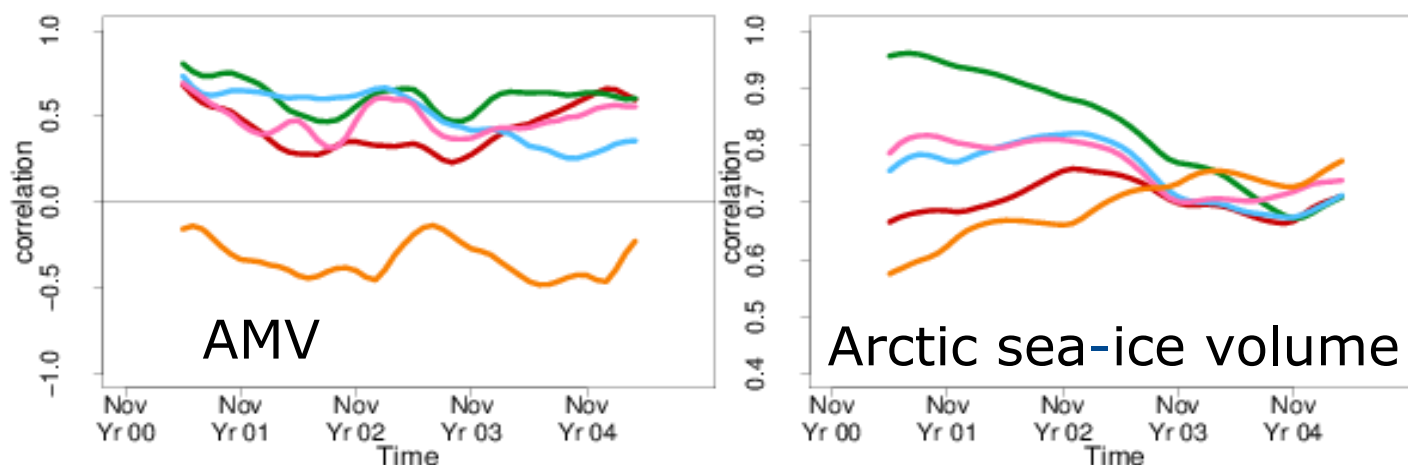
Our open fronts

- Work on initialisation: initial conditions for all components (better ocean and sea ice), better ensemble generation, etc.
- Model improvement: leverage knowledge and resources from modelling at other time scales, aim for a drift reduction, projections of volcanic and anthropogenic aerosols. More efficient codes.
- Forecast quality assessment: scores closer to user, reliability as main target, process-based verification.
- Attribution: new attribution approaches using predictions.
- More sensitivity to the users' needs: going beyond the assumption of needing downscaling, better documentation, demonstration of value and outreach.

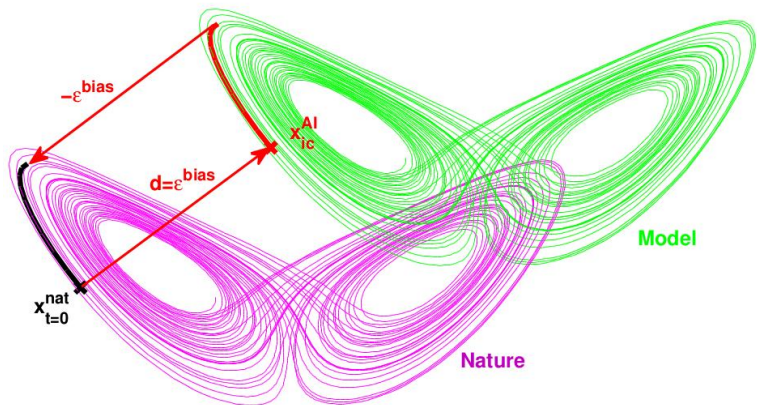
Assessment of full-field (**red**), anomaly in the ocean (**blue**), weighted anomaly in the ocean and the sea ice, with initialization of temperature and density instead of the usual temperature and salinity (**green**), and a weighted anomaly nudging in the ocean (**pink**).

Decadal prediction experiments run with EC-Earth2.3. Comparison with historical ensemble simulation (**orange**). 5 ensemble members, one start date every 2 years.

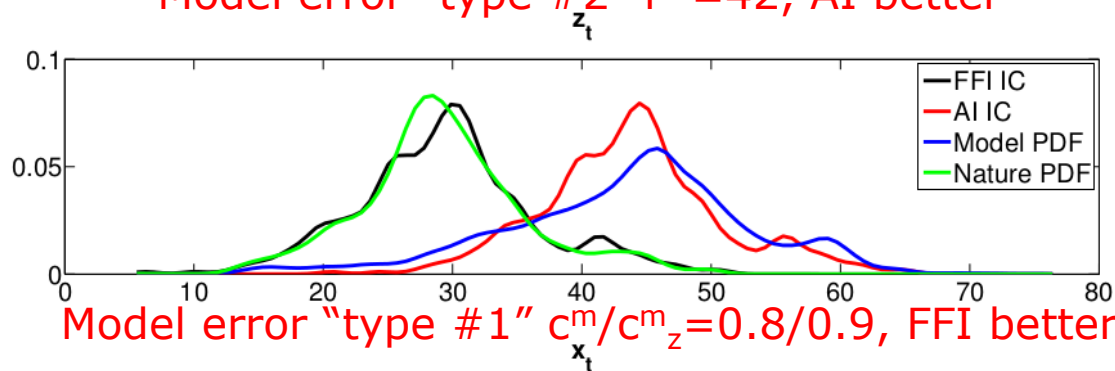
Reference data: ERSST for AMV and SST, sea-ice reconstruction from Guemas et al. 2013 for sea-ice area and volume.



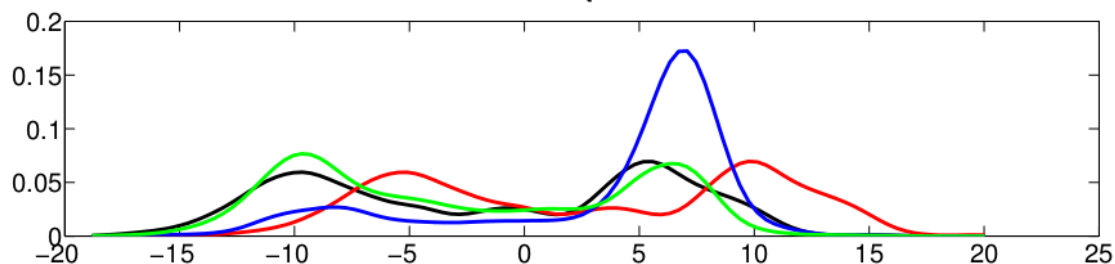
PDFs of initial conditions (black and red) and of the model and "nature" climatologies (blue and green) for the Peña and Kalnay model with three compartments (ocean, tropical atmosphere and extra-tropical atmosphere).



Model error "type #2" $r^m=42$, AI better

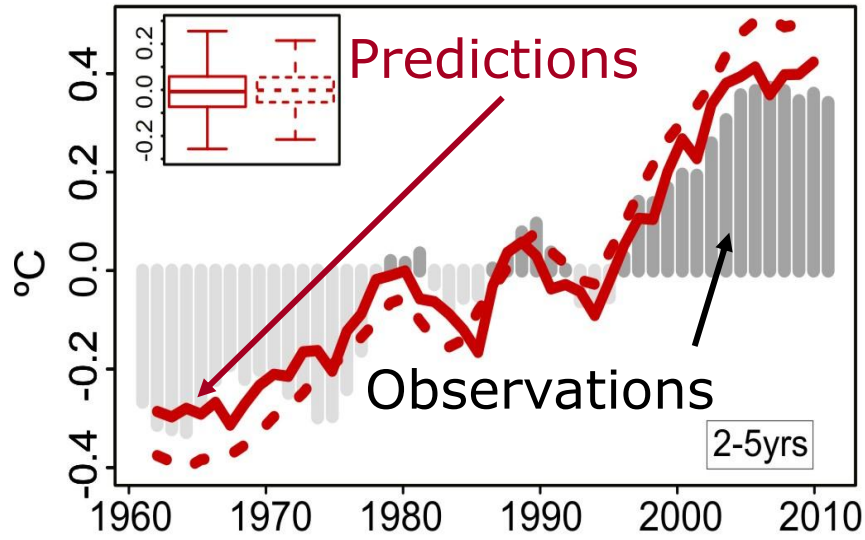


Model error "type #1" $c^m/c_z^m=0.8/0.9$, FFI better

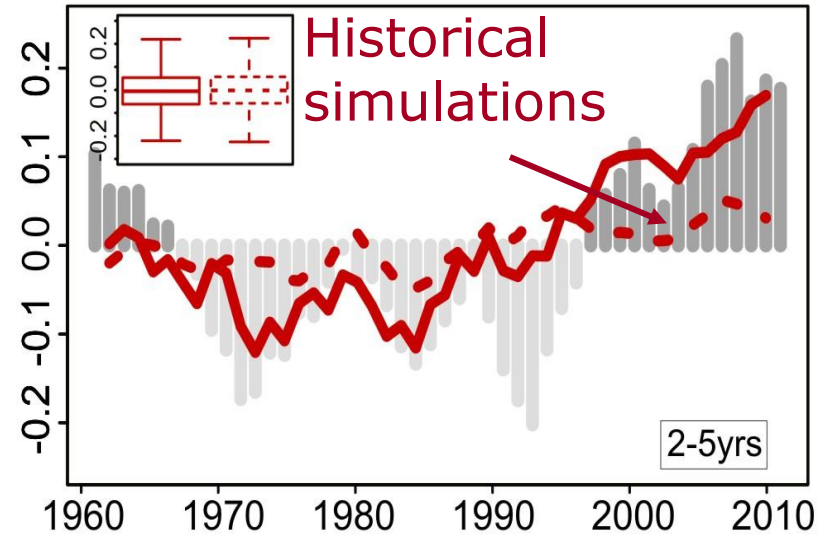


CMIP5 decadal predictions. Global-mean near-surface air temperature and AMV against GHCN/ERSST3b for forecast years 2-5. The initialized experiments reproduce the GMST trends and the AMV variability and suggest that initialization corrects the forced model response and phases in some of the internal variability.

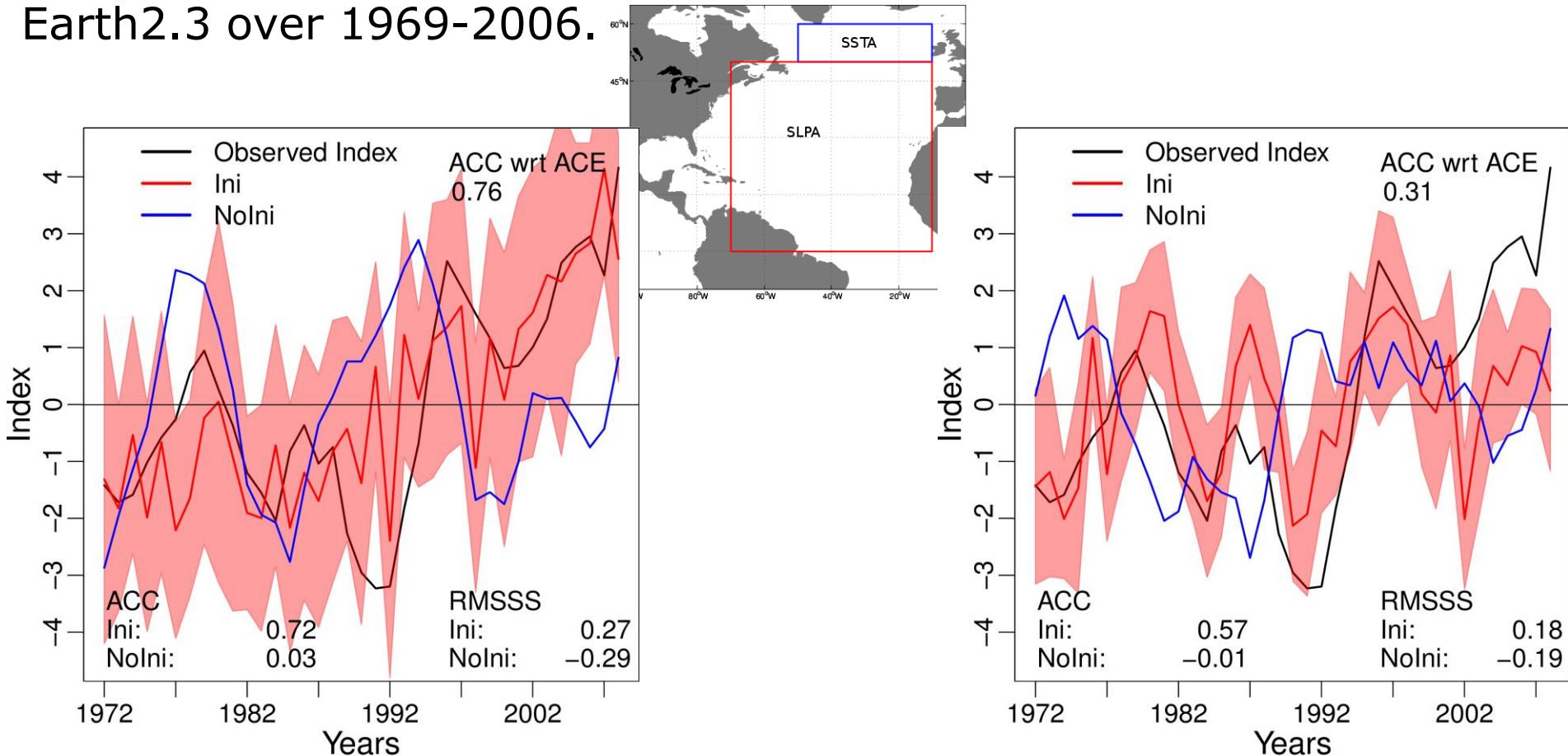
Global mean surface air temperature (GMST)



Atlantic multidecadal variability (AMV)

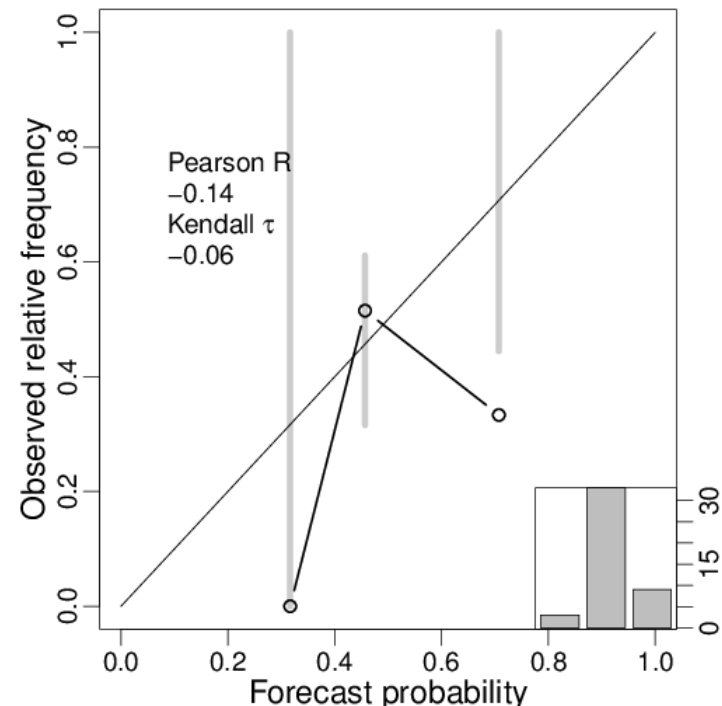
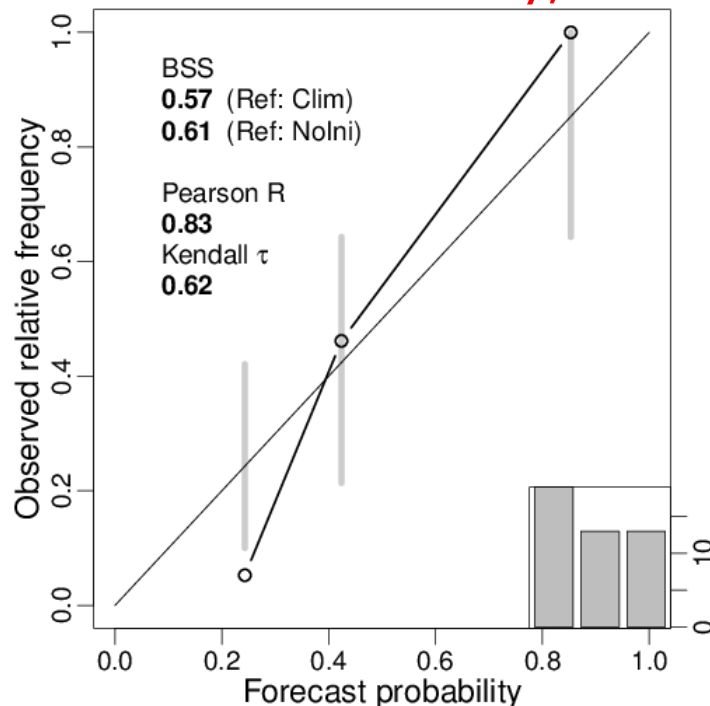


SST averaged over the subpolar gyre and MSLP averaged over the North Atlantic used to estimate basin-wide **accumulated cyclone energy** (ACE). Time series for 2-9 forecast year predictions with EC-Earth2.3 over 1969-2006.



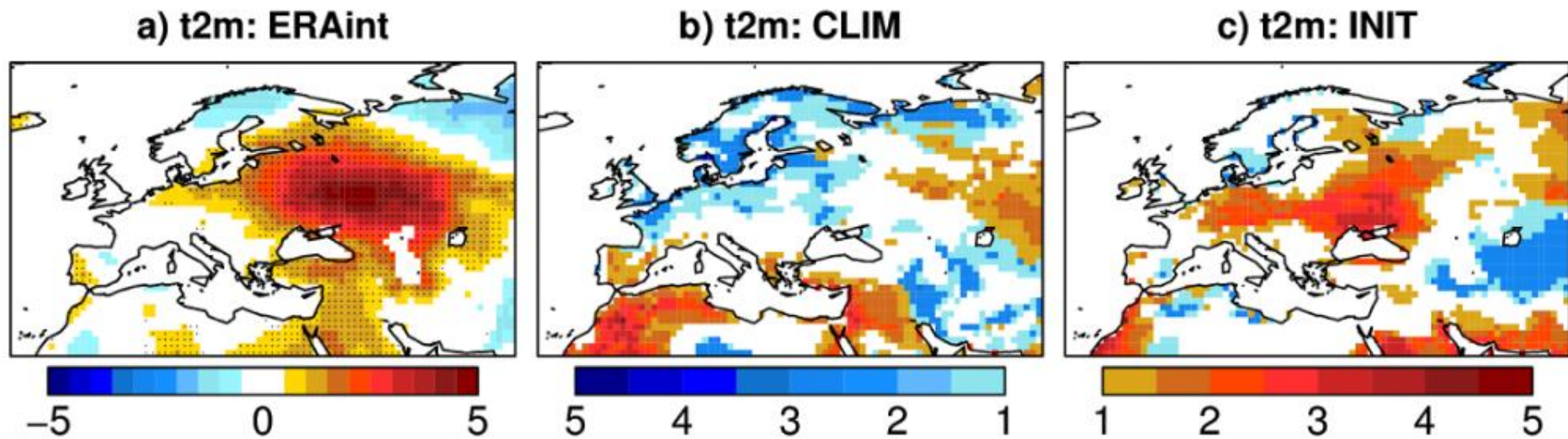
Reliability diagrams of left) initialised and right) uninitialised MME simulations for basin-wide **accumulated cyclone energy** (ACE). The results are for 2-9 year averages above the climatological median over 1961-2009. Statistically significant values are in bold.

Some of the added value of the predictions is their better management of uncertainty, which leads to increased **credibility**.



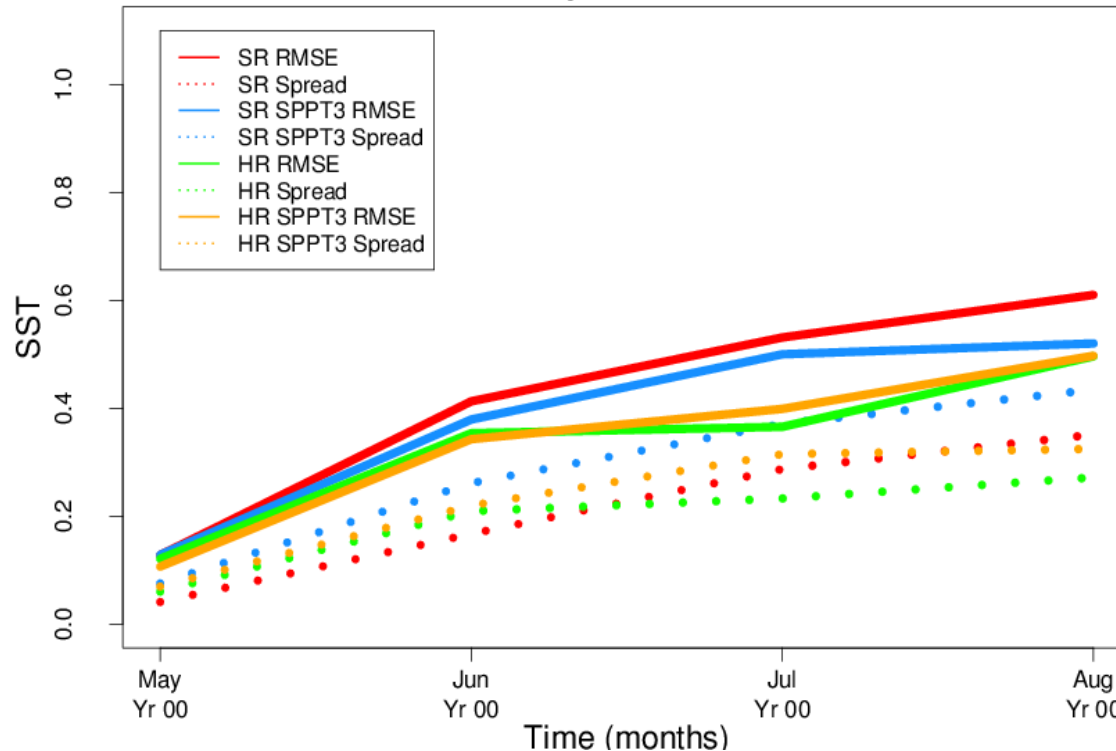
JJA near-surface temperature anomalies in 2010 from ERAInt (left) and odds ratio for anomalies above the upper quintile from experiments with a climatological (centre) and a realistic (right) land-surface initialisation. Results for EC-Earth2.3 started in May with initial conditions from ERAInt, ORAS4 and a sea-ice reconstruction over 1979-2010.

Land-surface initialization is relevant to predict extreme events.



High resolution has been thoroughly tested in climate prediction mode. The same applies to the stochastic physics.

RMSE and spread of Niño3.4 SST (versus ERSST) from EC-Earth3.0.1 simulations: standard resolution (**SR, T255/ORCA1**), high resolution (**HR, T511/ORCA025**) without and with **stochastic physics (SPPT3)**. 10.member ensembles for May start dates over 1993-2009 using ERA-Interim and GLORYS.



The multi-model real-time decadal prediction exchange is a research exercise that guarantees equal ownership to the contributors. WMO-CCI plans to sponsor this activity.

<http://www.metoffice.gov.uk/research/climate/seasonal-to-decadal/long-range/decadal-multimodel>

Multi-model decadal forecast exchange

The Met Office coordinates an informal exchange of near-real time decadal predictions. Many institutions around the world are developing decadal prediction capability and this informal exchange is intended to facilitate research and collaboration on the topic.

[The contributing prediction systems](#) are a mixture of dynamical and statistical methods. The prediction from each institute is shown below, alongside an average of all the models. When possible, observations for the period of the forecast are also shown. Currently three variables are included: surface air temperature, sea-level pressure and precipitation. These are shown as differences from the 1971-2000 baseline. More diagnostics, including ocean variables are planned for the future. Please use the drop-down menus below to explore the data collected to date.

This work is supported by the European Commission SPECS project.



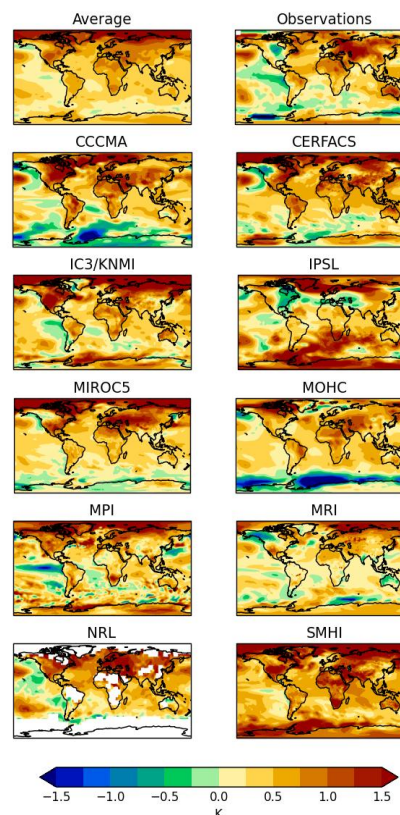
To learn more about decadal forecasts at the Met Office, see our current [decadal forecast](#).

Images last updated 2014-06-25

Issued Period Element

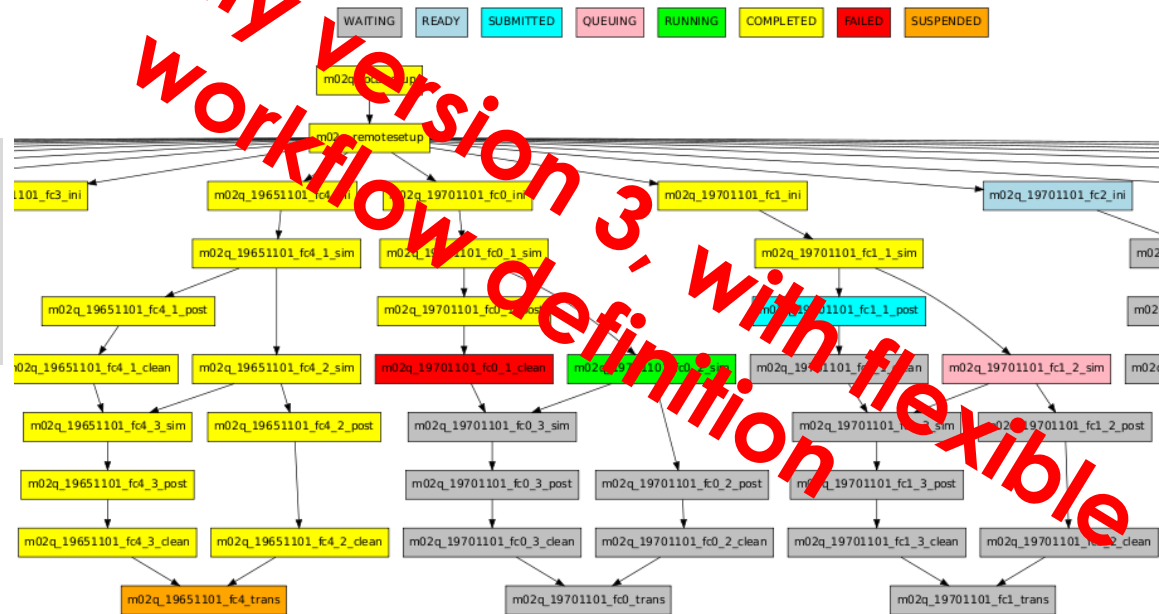
Decadal forecast exchange 2013 predictions for year 1 surface air temperature

2012 predictions for 2013 surface temperature



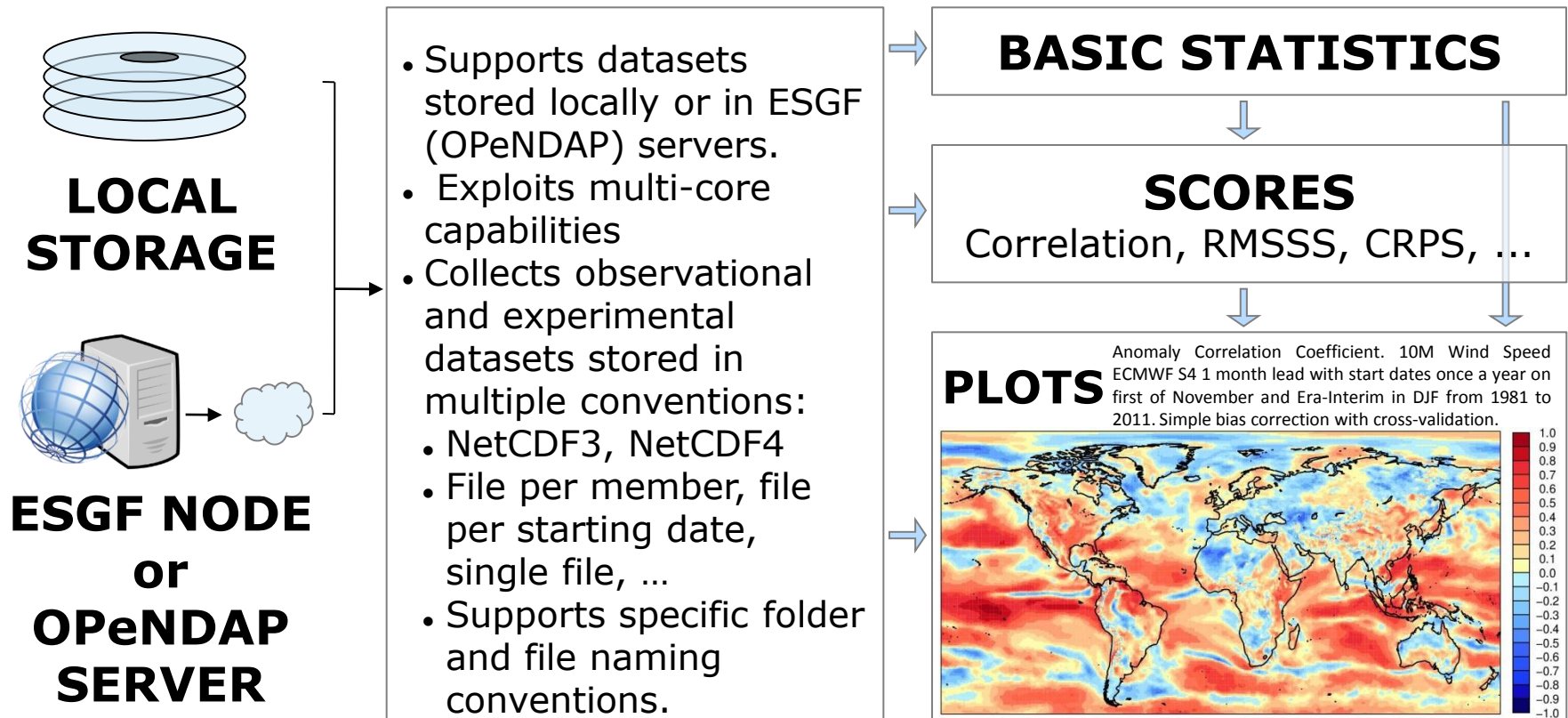
- **Automatization:** Preparing and running, postprocessing and output transfer, all managed by Autosubmit. No user intervention.
- **Provenance:** Assigns unique identifiers to each experiment and stores information about model version, configuration options, etc
- **Failure tolerance:** Automatic retrials and ability to repeat tasks in case of corrupted or missing data.
- **Versatility:** Currently runs EC-Earth, NEMO and NMMB models on several platforms.

Workflow of an experiment monitored with Autosubmit (yellow = completed, green = running, red = failed, ...)



Common tools for verification

S2dverification is an R package to verify seasonal to decadal forecasts by comparing experiments with observational data. It allows analyzing data available either locally or remotely. It can also be used online as the model runs. Available from CRAN.



■ MIPs (ensemble size in brackets)

DECK: AOGCM standard resolution, historical (5) and AMIP (1)

Decadal prediction (DCPP): components A (10), B (10) and C, possibly HR

ScenarioMIP: one scenario (5)

HiResMIP: coupled T511-ORCA025 (5)

VolMIP: initialized simulations with Pinatubo and Tambora forcing

SIMIP: sea-ice diagnostics

■ Data

Contribution to CMOR3 for climate predictions (e.g. double time axis)

Testing CMOR3 on different platforms

Preparation of tools for standardizing (CMORizing) the EC-Earth output

Implementation of a Spanish ESGF node, link to Big Data and downstream service developments

■ Infrastructure

Coordinate PRACE proposals

Release an Autosubmit version for EC-Earth partners

Increase model performance

- **Work on initialisation**: initial conditions for all components (better ocean and sea ice), better ensemble generation, etc.
- **Model improvement**: leverage knowledge and resources from modelling at other time scales, aim for a drift reduction, projections of volcanic and anthropogenic aerosols. More efficient codes.
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